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ABSTRACT

In spring 1977, just as California was emerging from one of the worst droughts in its history, 215 Palo Alto homeowners were interviewed about their views on energy and water conservation, and about the extent to which they had adopted 11 energy-conserving practices (ECP) in the home. The objective was to discover variables both important to respondents' decisions to conserve gas in their homes and influential as part of communication campaigns. House structure accounted for 29% of the variance in actual gas usage, with adoption of the 11 ECP explaining 9% of the remaining variance in gas usage. Adoption levels were predicted by the homeowner's assessment of the personal consequences of adopting each ECP, by ability to make home repairs, by past experience with shortages, and by awareness of a social norm or conservation ethic. The findings suggest that very practical and specific "how to" information, rather than persuasive communication aimed at changing general energy-related beliefs, is needed in the promotion of energy conservation. In addition, neighborhood information networks could prove effective channels for the diffusion of energy conserving practices. (Author/RL)

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ADOPTION OF ENERGY CONSERVATION AMONG CALIFORNIA HOMEOWNERS

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ABSTRACT

In Spring 1977, just as California was emerging from one of the worst droughts in its history, 215 Palo Alto homeowners were interviewed about their views on energy and water conservation, and about the extent to which they had adopted 11 energy-conserving practices (ECP) in the home. The objective of the research was to discover those variables which were both important in the respondents' decisions whether or not to conserve gas in their homes and were also susceptible to influence through communication campaigns.

House structure accounted for 29% of the variance in actual gas usage, as measured by utility records over a 12-month period. Adoption of the 11 ECP chosen for study explained 9% of the remaining unexplained variance in gas usage. Adoption levels were predicted by the homeowner's assessment of the personal consequences of adopting each ECP, by ability to make home repairs, by past experience with shortages, and by awareness of a social norm, or conservation ethic.

The authors conclude that very practical and specific "how-to" information is needed in the promotion of energy conservation, rather than persuasive communication aimed at changing general energy-related beliefs; neighborhood information networks could prove effective channels for the diffusion of energy conserving practices.

ADOPTION OF ENERGY CONSERVATION AMONG CALIFORNIA HOMEOWNERS

by

Dorothy Leonard-Barton and Everett M. Rogers*

An innovation is "an idea, practice, or object perceived as new by the individual" (Rogers with Shoemaker, 1971). To most of the world, energy conservation is not new. In the majority of homes around the globe, the difference between darkness and light during the night is still a half litre of kerosene or the stub of a candle. To a whole generation of U.S. citizens, however, the necessity of "scaling down" their energy consumption is new. An unfamiliar set of behaviors has to be assessed, learned, and maintained over time. Therefore the diffusion of energy conservation in the U.S. has entailed information-exchange, ranging from broadly targeted persuasive messages on television about the energy crisis to neighborly advice on how to weatherstrip windows..

This paper addresses the question of how and why some Californians appear motivated to adopt energy conserving practices leading to reduced gas consumption in their homes. Rather than concentrate on the varibles (e.g., cosmopoliteness, income, and education) utilized in past diffusion research to differentiate between adopters and non-adopters of a new idea, we focus on those factors which are particularly subject to influence by communication campaigns of information or persuasion. This concentration is achieved two ways: first, we measure beliefs and attitudes which the literature suggests may predict conserving behavior. Secondly, we attempt to control for those variables which may greatly influence adoption but which are not readily changed through communication campaigns, e.g., the type of home people live in; people's income

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levels.

A survey of 215 homeowners was conducted in early Spring, 1978, in Palo Alto, California. The state was just emerging from one of the worst droughts in its history. It was a time of local crisis, when brown lawns and unwashed cars were signs of virtue. The timing of the present study is both advantageous and disadvantageous for our purposes. Because our respondents were keenly aware of the water shortages, our findings invite extrapolation to a future crisis situation if and when energy is in short supply. Moreover, we are able to compare gas and water usage, to see if people are consistent in their consumption/conservation patterns across different commodities.* However, such a possible consistency also constitutes a disadvantage, in that if the water crisis encourages some people to temporarily conserve on other commodities, there is less variance in behavior to explain, and it is impossible to distinguish between long-term, deeply held beliefs and ephemeral, crisis-originated attitudes towards conservation. Under normal circumstances, variance in behavior may be wider.

The present study focuses on an hierarchical belief structure, an attitudinal and behavioral context in which the decision is made about whether or not to cut back on consumption. We assume that the innovation-decision about gas conservation is affected by many influences, ranging from broad-ranging considerations which provide a context for almost every daily decision a person makes, to more action-specific choices which are directly and closely related to particular energy usage behaviors in the home.

Figure 1 is a schematic presentation of the belief structure for energy conservation as we conceive it. We may picture the beliefs and behaviors which surround a particular decision as layered, like an onion. We move in this paper from an examination of the general contextual variables in the outermost layer through ever more directly relevant variable layers to the behavior-

*We found that energy and water consumption levels are significantly related among our respondents, r = .14.

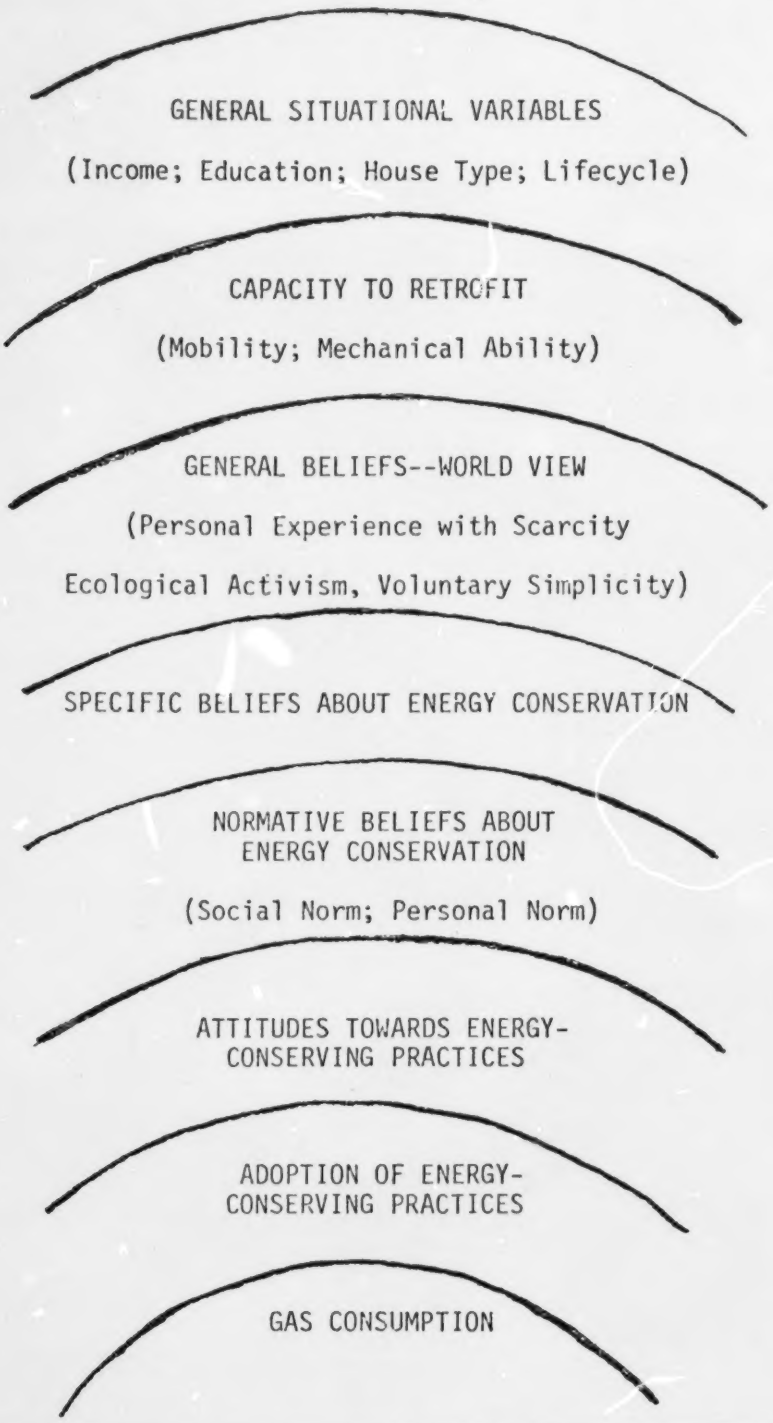

Figure 1

Variables Related to the Adoption of Energy-Conserving Practices

specific beliefs close to the heart of the subject, namely adoption of energy-conserving practices in the home.

Eleven energy-conserving practices (hereafter referred to as ECP) are considered, divided into two types: (1) those which require a one-time investment of time or money, but which do not necessitate changes in family routine (installing wall or ceiling insulation, solar water heating, a furnace timer, or weatherstripping doors and windows), and (2) those which require changes in family routine (turning off furnace pilot lights during the summer, closing drapes at night, washing clothes in cold water, lowering furnace thermostats to 65° daytime, cleaning refrigerator condenser coils, lowering hot water heater thermostats to 120°).* See Table 1.

In addition to eliciting these self-reports of adoption levels, we also obtained from the city-run utilities company, records of the gas used in the survey households during the year 1977-78.

We have, then, two dependent variables, each somewhat incomplete but serving as mutual validity checks. The self-reports of adoption may be subject to some distortion because of response bias.** The gas consumption figures, while adjusted for house size and occupancy, are likewise still imperfect measures of conscious conserving behavior, since the physical orientation of a house (north or south) can have a great effect on the major use of gas in the home -- heating.***

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*For both types of ECP, the measure of adoption was not dichotomous. Respondents were asked if they "always, usually, sometimes or never" engaged in the changes in routine, and if they had "not considered," or had considered and "would not," "might," "planned to," or "had," adopted an "investment" ECP.

**However, the likelihood of inflated reports is somewhat reduced in this research for two reasons: (1) our respondents had already given us written permission to utilize figures on their gas consumption and were therefore aware that their answers would be compared to "hard" data, and (2) while it is tempting and easy to exaggerate acts of conserving behavior such as turning down thermostats, it is not quite as easy to say one plans to insulate (i.e., has obtained materials or cost estimates) or has already insulated the ceiling.

***Houses oriented towards the south, especially if there are large windows on the southern exposure, have an often unintended passive solar design and are likely to require much less heat in winter.

Table 1.

Adoption of Energy-Conserving Practices: Frequency Count/

Routine CPs

Item		Never	Occasionally	Usually	Always
Turn off the furnace pilot lights during the summer	Freq.	107	17	21	68
	Percent	(50.2)	(8.0)	(9.9)	(31.9)
Wash clothes in warm or cold water rather than hot	Freq.	7	38	54	112
	Percent	(3.3)	(18.0)	(25.6)	(53.1)
Turn the furnace thermostat down to 65° daytime, lower at night	Freq.	29	24	37	120
	Percent	(13.8)	(11.4)	(17.6)	(57.1)
In winter, close drapes at night, open during the day	Freq.	22	22	61	108
	Percent	(10.3)	(10.3)	(28.6)	(50.7)
Clean condenser coils on refrigerator regularly	Freq	89	53	33	36
	Percent	(42.2)	(25.1)	(15.6)	(17.1)
Set thermostat on hot water to 120° (or 140° if dish-washer).	Freq.	36	5	26	116
	Percent	(19.7)	(2.8)	(14.2)	(63.1)

Investment/CPs

Item		Have Done	Plan To Do	May Do	Will Not Do	Have Not Considered
Weatherstrip or caulk windows and doors to eliminate drafts	Freq.	109	28	28	16	34
	Percent	(50.7)	(13.0)	(13.0)	(7.4)	(15.8)
Insulate exterior walls of the house	Freq.	42	7	30	61	75
	Percent	(19.5)	(3.3)	(14.0)	(28.4)	(34.9)
Insulate ceiling of the house	Freq.	100	10	33	35	36
	Percent	(46.7)	(4.7)	(15.4)	(16.4)	(16.8)
Install solar water heating (inside consumption)	Freq.	1	5	42	38	128
	Percent	(0.5)	(2.3)	(19.5)	(17.7)	(59.5)
Install timer on heating system	Freq.	9	7	12	21	163
	Percent	(4.2)	(3.3)	(5.7)	(9.9)	(76.9)

The two measures (adoption of ECP and gas consumption) are significantly related ($r = -.31$; $p < .001$). Undoubtedly the correlation would be stronger if more ECP had been included in the study. For although the 11 ECP were chosen because of their potential to effect considerable savings in gas, it is entirely possible for people to cut back on gas usage in ways not mentioned in the present study.*

In this paper we will consider first those independent variables which correlate with each of the dependent variables (adoption and gas consumption) and then, by examining those variables in stepwise regressions refine a suggested model of energy conserving behavior to be further tested in future work.

Adoption of ECP: Correlates

While the study of behavioral correlates to energy conservation is in its infancy, a number of studies have shown that, nationwide, conscious energy-conservers tend to be well-educated, youngish suburbanites with a relatively high income (Milstein, 1977). Except for age, residents of Palo Alto, California would seem to fit this demographic profile well. Therefore the present study was centered in Palo Alto, in an attempt to isolate those variables beyond demographics which influence energy use, and especially those with implications for communication campaigns (see Figure 2).

a. Capacity to Retrofit

None of the situational variables which provide a general decision-making context are significantly related to adoption of ECP. However, both of the variables which are hypothesized to impact on decisions about house renovations (Capacity to Retrofit) do relate to adoption levels. As expected, the more mobile these homeowners are, (measured by their expectations of moving from

*For instance, one respondent in the pilot study phase of this research cut down shade trees in her back yard, and replaced her radiant floor heating system with a wood stove fed by the felled trees. Moreover, she boarded up many large windows and lowered heavy canvas screens over others to hold the heat in.

GENERAL SITUATIONAL VARIABLES

(Income; Education; House Type;** Lifecycle)

r = .19

CAPACITY TO RETROFIT

(Mobility;* Mechanical Ability***)

r = -.12 r = .22

GENERAL BELIEFS--WORLD VIEW

(Personal Experience with Scarcity;*

r = .15

Ecological Activism; Voluntary Simplicity***)

r = .28

SPECIFIC BELIEFS ABOUT
THE ENERGY CRISIS

NORMATIVE BELIEFS ABOUT
ENERGY CONSERVATION

(Social Norm;*** Personal Norms***)

r = .29 r = .24

ATTITUDES TOWARDS ENERGY-
CONSERVING PRACTICES***

r = .32

ADOPTION OF ENERGY-
CONSERVING PRACTICES

Figure 2. Schematic Presentation of the Variables Which Relate to Adoption of Energy-Conserving Practices

*p $<$.05

**p $<$.01

***p $<$.001

the present house as well as by their history of mobility) the less likely they are to adopt ECP ($r = -.12$). People are evidently uncertain that they will get a return on investments such as insulation or weather-stripping if they occupy a house only a short time.

The presence of someone in the home capable of making small repairs and undertaking such tasks as weatherstripping (Mechanical Ability) is also related to people's reported adoption of ECP ($r = .22$). We will return to a discussion of this variable later, since it emerges as one of the most significant predictors of energy conservation, particularly of adoption of energy conservation by investing in structural changes (as contrasted to behavioral changes in routine use of energy).

b. General Beliefs - World View

Among the general beliefs which presumably provide a context for all decisions regarding consumption, our respondents' personal experience with scarcity relates positively to their intent to adopt and their actual reported adoption of ECP. Despite this relationship, there is no correlation between the experience variable and actual gas consumption. That is, people who have experienced shortages report adopting more ECP than do their neighbors, but use no less gas. The reason for this apparent discrepancy between self-report and behavior becomes clear when the ECP are divided into (1) changes in routine, and (2) one-time investments; these respondents are no more likely than other homeowners to adopt changes in household routine which save energy (e.g., turning down thermostats). However, they tend to express an interest in and to report adopting those ECP which require no family sacrifices beyond the inconvenience of construction (e.g., installing insulation). Perhaps these respondents share a "nest-building" or "hoarding" philosophy expressed by several respondents as follows: "We don't want our children to have to be as constrained as we were by poverty; we know what it is like to have to conserve and we will prepare

for the worst, but we won't force our families into a Spartan living style until absolutely necessary."* Their disinclination to change routine and risk lowering family comfort levels leads to high gas consumption at the same time that their investment in energy-saving home improvements cuts their fuel bills; the two tendencies cancel each other out.

The other variable in the layer of general beliefs and world views which relates to adoption of ECP is a cluster of behaviors we term "Voluntary Simplicity." This set of behaviors (see Table 2) is a rudimentary version of a multi-dimensional scale being developed to measure respondents' sympathy toward, and adoption of a "scaled-down" lifestyle.

The term "Voluntary Simplicity" was adopted by SRI International researchers Duane Elgin and Arnold Mitchell to describe a particular lifestyle centered around five values: material simplicity, human scale, self-determination, ecological awareness and personal growth (Elgin and Mitchell, 1976). From the literature on Voluntary Simplicity (including reported interviews with people who claim to be living a life of whole-hearted Voluntary Simplicity),we derived a few representative behaviors (choosing ones which were feasible for Palo Alto homeowners). Considered individually, each of these behaviors may be adopted for idiosyncratic reasons unrelated to Voluntary Simplicity. The more of these behaviors a person engages in, however, the more likely it is that the actions stem from a cohesive philosophy supporting scaling down and self-sufficiency.** Energy-conserving practices are evidently compatible with this

*An alternative explanation that these respondents both experienced shortages (during the Depression) and use more gas because they are older, can be rejected. The personal experience variable does not relate to age.

**For example, a person might garden for recreation, or might prefer vegetarian food for religious reasons, or might buy second-hand clothes for purely economic reasons. However, our contention is that someone who engages in all these diversified activities does so because these behaviors fit a general lifestyle pattern. Since these behaviors are characteristic of Voluntary Simplicity, the motives which impell these clusters of behaviors are assumed to be at least similar to those which motivate the conscious adoption of a Voluntary Simplicity life style.

Table 2. Voluntary Simplicity

Items in Scale	Absolute Frequencies	Percent
Belong to a Briarpath organization, cheese co-op or other food cooperative in which you are required to provide some of the labor.	16	7.4
Plan (purposely) to have meatless main meals one or more times a week.	118	54.9
Recycle newspapers	182	84.7
Recycle glass jars	129	60.0
Recycle aluminum cans	137	63.7
Buy clothing at a second-hand store	63	29.3
Buy a major item of furniture or clothing at a garage sale (over $15)	51	23.7
Grow 25% or more of the vegetables you and your family consume during a summer season.	35	16.3
Have exchanged good or services with others in lieu of payment with money, e.g., babysitting co-op or repairing equipment in exchange for other skilled work.	57	26.5

N = 215

set of behaviors, for the Voluntary Simplicity scale relates significantly to adoption of ECP.*

c. Normative Beliefs

Both social normative belief (measured as the conviction that others think energy conservation is important and believe I should conserve energy) and personal normative belief (measured as the conviction that I believe I should conserve energy, regardless of what others think I should do) relate to adoption of ECP. There is, of course, no assumption of causality in this finding. People may adopt ECP first and derive from their action normative beliefs which are anchored either in referent groups or in themselves.

d. Attitudes Towards Energy - Conserving Practices

Likewise, in the relationship ($r = .32$) between assessment of the consequences of adopting the ECP (attitudes towards ECP) and adoption, causation cannot be assigned. Our respondents may be adopting the ECP because they have made a favorable assessment of the attributes of the ECP (e.g., energy savings, convenience, structural feasibility, payback) and are thereby motivated to adopt them. On the other hand, people who have already adopted ECP may combat potential cognitive dissonance by convincing themselves that the ECP save energy, are convenient, will pay for themselves out of utility bill savings, etc.

Gas Consumption Correlates

Our assumption from the first in this study was that house structure largely determines the amount of gas consumed in gas-heated homes since heat loss varies enormously among differently constructed buildings.** The total study

*This Voluntary Simplicity scale was also used in a small pilot study of 25 people who had solar equipment installed in their homes. The solar adopters on the average rated much more highly on the scale (5.3) than did the 215 Palo Alto homeowners in the present study (average score 3.6).

**Morrison (1975) found that house structure accounted for 33 percent of the variance in energy usage; lifestyle variables (mostly socio-economic descriptors) added only 9.6 percent to the total variance explained.

sample was drawn from three subdivision neighborhoods, each neighborhood composed of identical structures built at the same time. This sampling method allowed us to (1) vary the type of structure somewhat so that our findings about the adoption of ECP would not be totally tied to structural considerations, (2) obtain sociometric data on information networks with each neighborhood,* and (3) control for the effects of house structure on gas usage.

We found that house type predicts 29 percent of the variance in gas consumption. Because this variable was not of primary interest in the study (communication about energy conservation can affect choice of house, but we are trying in the present study to identify what variables influence energy use in peoples' current situations), we extracted through regression the effects of house type on gas usage, and proceeded with our analysis, using the residual unexplained variance in gas consumption as one of our dependent variables. Presumably, since we also controlled for house size (including additions, remodeling, etc.) and occupancy, the residual gas figure represents discretionary gas usage,** that is, the gas consumption levels reflect personal and lifestyle choices.

As expected, many of the same independent variables which related to adoption also correlate significantly with gas consumption (see Figure 3). It is somewhat surprising however, that education, belief in the energy crisis and ecological activism relate to gas usage, since they do not relate to reported adoption levels. These three measures intercorrelate ($p < .01$), so tend to identify the same respondents. Evidently these households cut down on gas usage in ways other than the 11 suggested. In fact, the ECP listed in the study were considered to be inadequate conserving behaviors by some respondents. For instance, instead of turning the thermostat down to 65° at night some home-

*An example of this data will be presented later in the paper.

**As we will note later, in fact there are idiosyncratic structural variables which were not totally accounted for even by this careful procedure.

GENERAL SITUATIONAL VARIABLES

(Income; Education**)

r = -.16

CAPACITY TO RETROFIT

(Mobility; Mechanical Ability**)

r = -.19

GENERAL BELIEFS--WORLD VIEW

(Personal Experience with Scarcity;
Ecological Activism;** Voluntary Simplicity**)

r = .16 r = .18

SPECIFIC BELIEFS ABOUT
THE ENERGY CRISIS**

r = -.15

NORMATIVE BELIEFS ABOUT
ENERGY CONSERVATION

(Social Norm;** Personal Norm)

r = -.12

ATTITUDES TOWARDS ENERGY-
CONSERVING PRACTICES*

r = -.11

ADOPTION OF ENERGY-
CONSERVING PRACTICES**

r = -.31

GAS CONSUMPTION[a]

Figure 3. Schematic Presentation of the Variables Which Relate to Gas Consumption

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[a]Gas consumption is a regression residual after the variance in consumption explained by house type and lifecycle has been removed.

*p < .05
**p < .01
***p < .001

owners said they turned their heating systems completely off. In our structured interview, there were inadequate means for accounting for such idiosyncratic ECP.

While the personal norm related to gas consumption in the expected direction ($r = -.09$), the correlation failed of significance at the $p < .05$ level. The evidence suggests that social pressures are more closely tied to gas use than are personal convictions,* since the social norm does relate significantly to gas use. As expected both attitudes towards the 11 ECP (attribute assessment) and reported adoption levels relate to gas consumption. We will discuss the implications of this finding later in the paper.

A Proposed Paradigm of Energy Conserving Behavior

The importance of the variables relating to adoption and gas usage were tested in two stepwise regressions resulting in a very much refined model.

When all significantly related independent variables are entered into a stepwise regression on gas consumption** only adoption of ECP predicts significant variance. It appears that although some beliefs are related to energy usage, none of these attitudinal variables directly predicts how people use gas in their homes. The only significant direct determinant of gas conservation is the adoption of specific behaviors and techniques to save. It is therefore important to consider the indirect determinants of energy conservation, namely what motivates adoption of ECP.

All significantly related independent variables were likewise entered into a stepwise regression on adoption, after the variance due to house type (about

*Further support for this statement is provided by the finding that the social norm is more strongly related to ecological activism than is the personal norm. It may be that those persons involved in environmental organizations feel more keenly than others the energy ethic and the peer pressure to conserve.

**After the effects of house type are removed.

four percent) was removed from adoption.* As Table 3 shows, four variables predict 20 percent of the variance. These two regressions result in a greatly modified model of energy conserving behavior (see Figure 4).

a. Attitudes Towards ECP

It is not surprising that attitudes towards the ECP, or more correctly, an assessment of the personal consequences of adoption (e.g., the relative convenience, structural feasibility, and safety of doing so, and the amount of energy which would be likely to be saved) predicts adoption.

The significance of this finding is that homeowner perceptions in part determine the spread of conservation. The same ECP may be acceptable to one person and totally unacceptable to another, who foresees potentially unpleasant personal consequences. Moreover, the perceived attributes (both extrinsic, such as availability of loans, guarantees, and convenience of purchase; and intrinsic, such as safety, reliability, potential harm to the environment, etc.) may or may not be the same as the actual "objective" attributes of that ECP. Consumer perceptions of the ECP attributes determine their pre-disposition to accept the ECP; the actual attributes, as homeowners experience them, will determine maintenance of the conserving behavior.

Communication campaigns have a potentially large role to play in influencing the formation of those important perceptions, and in informing the public about the actual attributes which emerge as the ECP are continued over time.

*While the structure of a house affects the adoption of ECP much less than it does gas consumption, there are some systematic differences between house types. For instance, in one group of tract houses, weatherstripping is difficult; all the doors and windows are sliding. On these same houses, the heating system is so slow to respond that homeowners have to anticipate desired heating levels about four hours in advance. Such structural constraints obviously affect peoples' willingness to adopt ECP and add some systematic biases not entirely covered by the measurement of specific ECP, i.e. the assessment of ECP attributes.

Table 3. Step-Wise Regression of Predictor Variables on Adoption of ECP[a]

Predictor Variable	Multiple Correlation Coefficient (Multiple R)	Contribution to Explained Variance (R^2 Change)	F Statistic for Regression Coefficient (df = 1, 207)	Total Variance Explained at Each Step (R^2)
Attitudes towards ECP	.32	.10	7.7**	.10
Mechanical Ability	.37	.04	8.8***	.14
Social Norm	.42	.035	3.2*	.175
Personal Experience with Scarcity	.145	.025	5.7**	.20

[a]After the effects of house type have been removed from adoption.

*p = .06
**p < .05
***p < .01

Variables Voluntary Simplicity, Mobility, and Personal Norm were also entered into the equation, but failed to predict significant variance. The regression coefficient for the Social Norm becomes highly ($p < .01$) significant when the Personal Norm, with which it is correlated .60, is omitted totally from the equation. Personal Norm contributes only .001 to the total variance; therefore, its omission does not lessen variance explained.

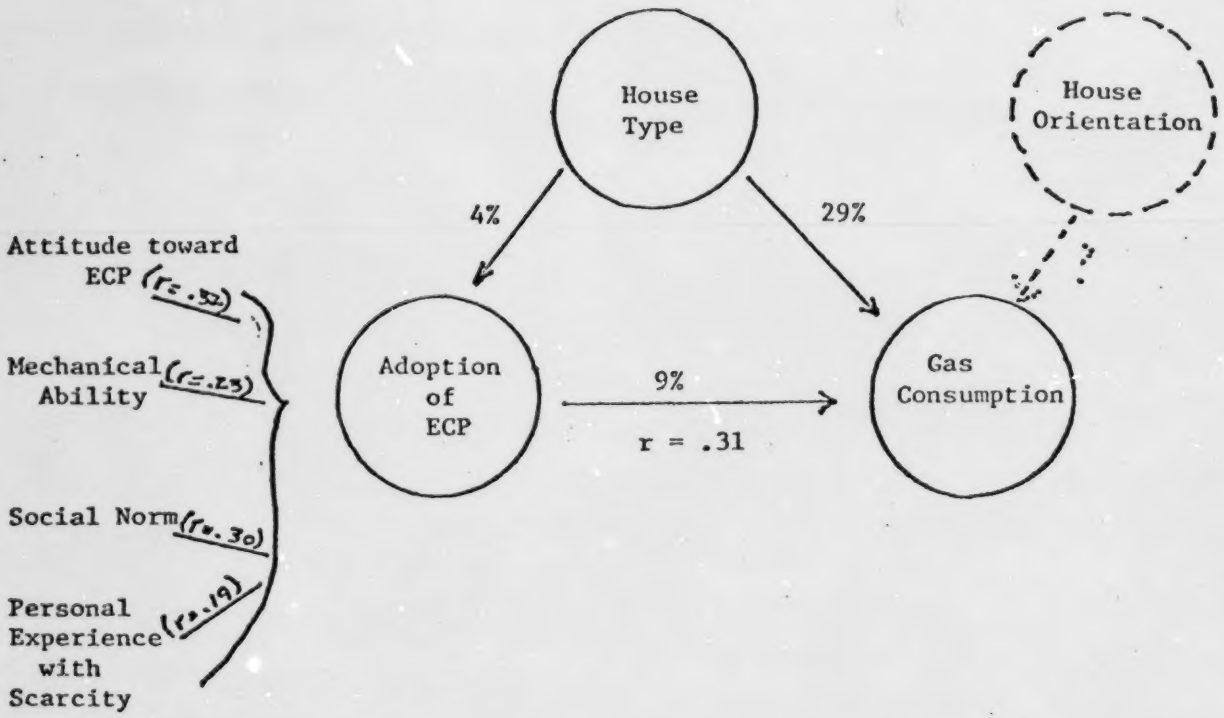
House Type
House Orientation
4%
29%
Attitude toward ECP (r=.32)
Mechanical Ability (r=.23)
Social Norm (r=.30)
Personal Experience with Scarcity (r=.19)
Adoption of ECP
9%
r = .31
Gas Consumption

Figure 4.

Perceptions (evaluations of outcomes) built on doubt or misunderstanding are obviously subject to some influence through information. Asked to judge whether or not solar equipment in the home would pay for itself in utility bill savings, our respondents were almost evenly divided between "don't know" or "will not" on the one hand, and those who said solar would pay back investors on the other. Likewise, 50 percent of the sample did not know whether solar energy installations would increase or decrease their house values. As more and more tax credits are legislated, information about the economics of solar installation may crucially affect homeowner perceptions -- if the information reaches them from credible sources.

Many perceptions of ECP (and hence inclination or disinclination to adopt) are based on inadequate know-how. Forty-four percent of our sample did not know how to turn off furnace pilot lights during the summer, for instance, and 30 percent felt (erroneously) that insulating the walls of their homes is structurally infeasible.

b. Mechanical Ability

As Table 1 and 2 indicate, one key factor in determining the ease with which ECP can be adopted by these homeowners is the presence of a "handyman" in the household who is competent to judge the difficulties and benefits of insulating or weatherstripping, etc., and who can undertake the work himself. This interpretation of the data is further substantiated by the finding that mechanical ability relates significantly only to the investment ECP, not to changes in family routine. Also people who are handy around the house are more likely to center recreational interests in the home, to spend time on home improvements in general.

c. Social Norm

The presence of the social norm in this very constrained regression model

may be taken as evidence that the views of friends and neighbors influence the adoption of ECP, as they do the acceptance of most new ideas. People use each other as reference points and as sources of practical information. This point will be elaborated below in a discussion of how "word-of-mouth" advertising (Whyte, 1954) works in the case of the diffusion of energy conservation among neighbors.

d. Personal Experience with Shortages

Finally, it appears that some of our respondents base their attitudes towards adoption of ECP partly on their own experience with other types of conserving behavior which they undertook in response to other shortages in the past. Unwilling to alter their family routine in order to save energy, they are nevertheless willing to guard against future hardships by making their homes more energy-efficient now. For these people, investing in making their homes energy efficient may be a kind of insurance.

Neighborhood Energy-Information Networks

In the present study, mechanical ability and the social norm are predictors of ECP adoption. This finding suggests that know-how and a feeling of shared priorities, that is, the belief that others in one's reference group consider conservation to be important, are determinants of conserving behavior. To understand how the norms and know-how spread among neighbors, we obtained sociometric data from the three neighborhoods studied.* The following data presented are all from one neighborhood; a middle-income group, housed in uninsulated, flat-roofed structures with a large proportion of glass in floor-to-ceiling windows and sliding doors. These houses are very energy inefficient.

First, we determined gas usage patterns in the neighborhood, comparing this group of homeowners with the entire sample, which was divided according to gas usage into quartiles (see Figure 5). Note that while a majority of homeowners

*For a thorough discussion of communication networks, see Rogers and Kincaid, in press.

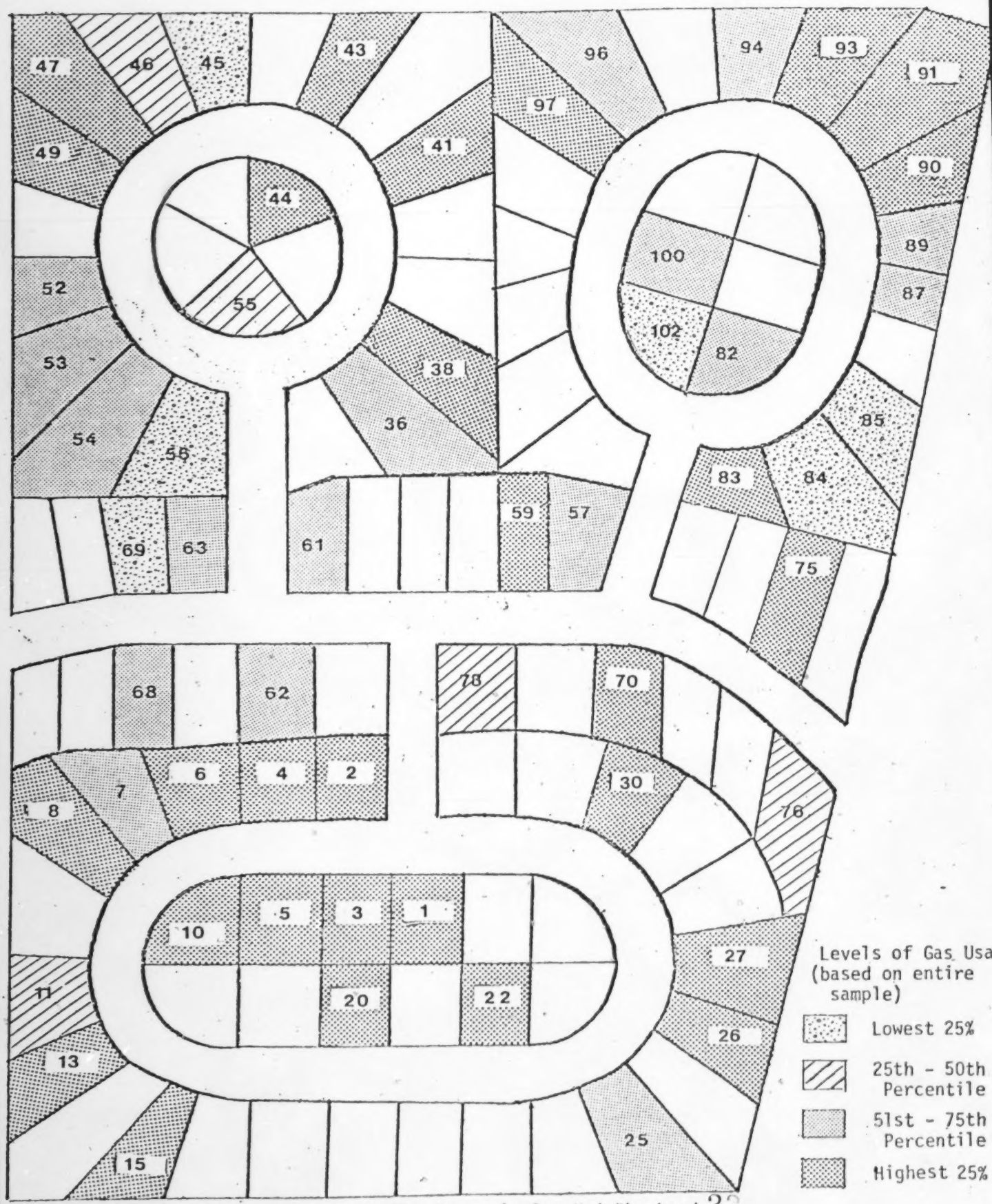

FIGURE 5: Levels of Household Gas Usage in One Neighborhood

fall in the highest gas use quartile, several in the upper half of this neighborhood map are in the lowest 25th percentile. Respondent number 45 (upper left) has solar water heating equipment.

Next we attempted to identify the opinion leaders on energy conservation in the neighborhood by asking who conserves the most energy (Figure 6), and who is the best source of information about energy conserving practices (see Figure 7). Not surprisingly, there was no consensus in the lower neighborhood section about who was the most dutiful conserver, since most of these homeowners were in the upper 25th percentile in gas usage. However, there was more general agreement about gas conservers among respondents in the upper half of the map. Out of four households identified by respondents as energy conserving, three were indeed in the lowest 25th percential of gas usage. The fourth (#36) was in the upper 50th percentile.

Homeowners in this part of the neighborhood were also in somewhat better agreement on sources of information about energy conserving, than their neighbors in the bottom half of the map. Number 102 (upper right) is obviously considered to be a good source of information; the one solar adopter in the sample (#45) and his neighbor (#46) also appear to be opinion leaders on the topic.

Finally, we mapped the cliques* in the neighborhood by determining the linkages among homeowners** (see Figure 8) through the use of a computer program called NEGOPY. Through this program the researchers can group the respondents and identify both "isolates" (individuals who do not belong to just one cliqueand who communicate with individuals in two or more cliques). As previous research on social networks showed (Granovetter, 1973) such liaisons perform an extremely important function in the transfer of information through "weak links."

*A clique is a group of three or more individuals who report a majority of interactions with each other.

**This kind of sociometric information is often obtained by determining who talks to whom, e.g., by asking "Who do you talk about_____ with in the neighborhood?" In our sample, as Figure 6 indicates, we asked our respondents to mark on a map of the neighborhood, those homes which they had been inside of at least once. This measure was designed to exclude casual passing greetings between neighbors and limit the links measured to more extensive social exchanges.

Question: "Who conserves the most energy in the neighborhood?"

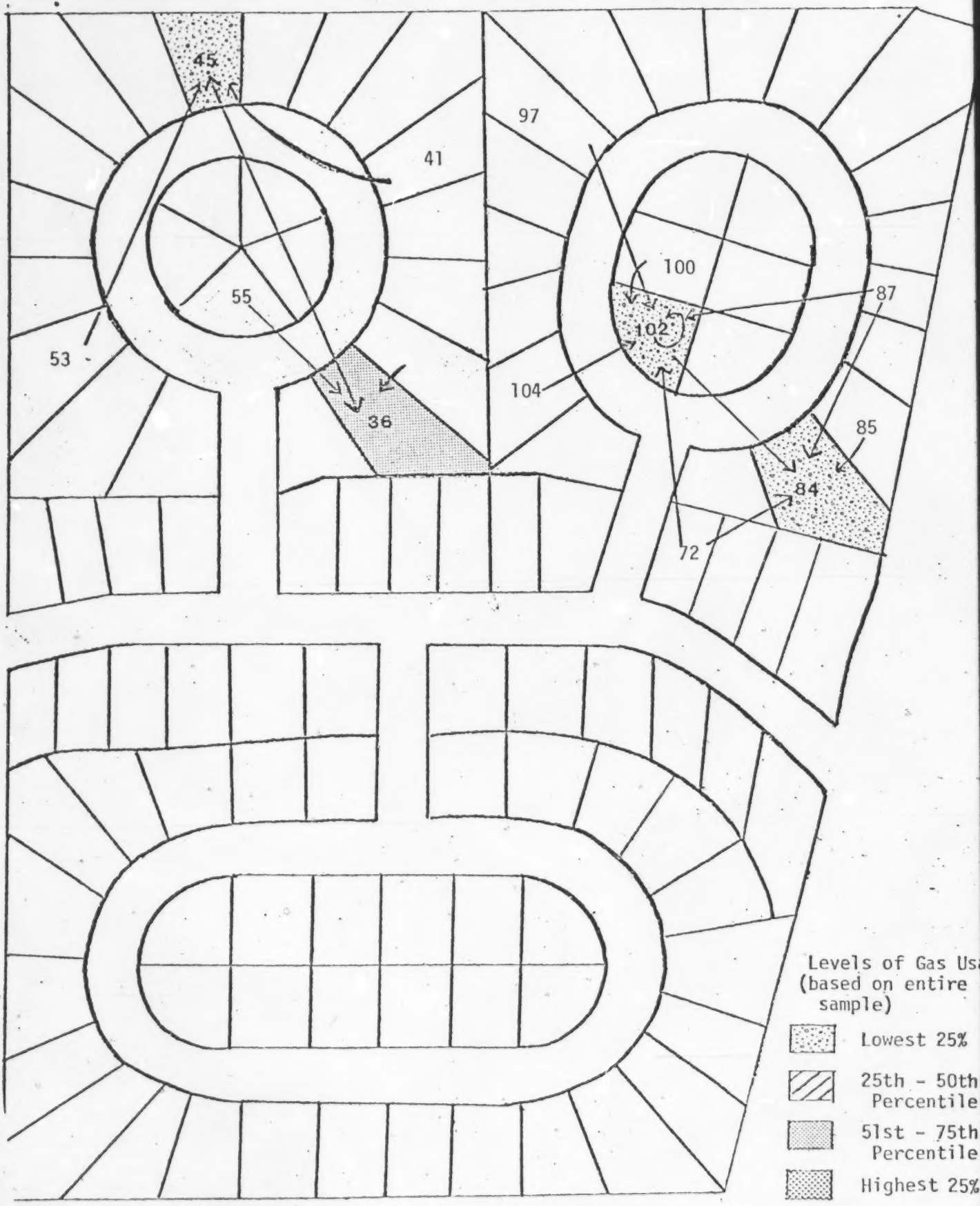

FIGURE 6: Households Designated as Conserving

Question: Who in the neighborhood is the best source of information about energy conservation?

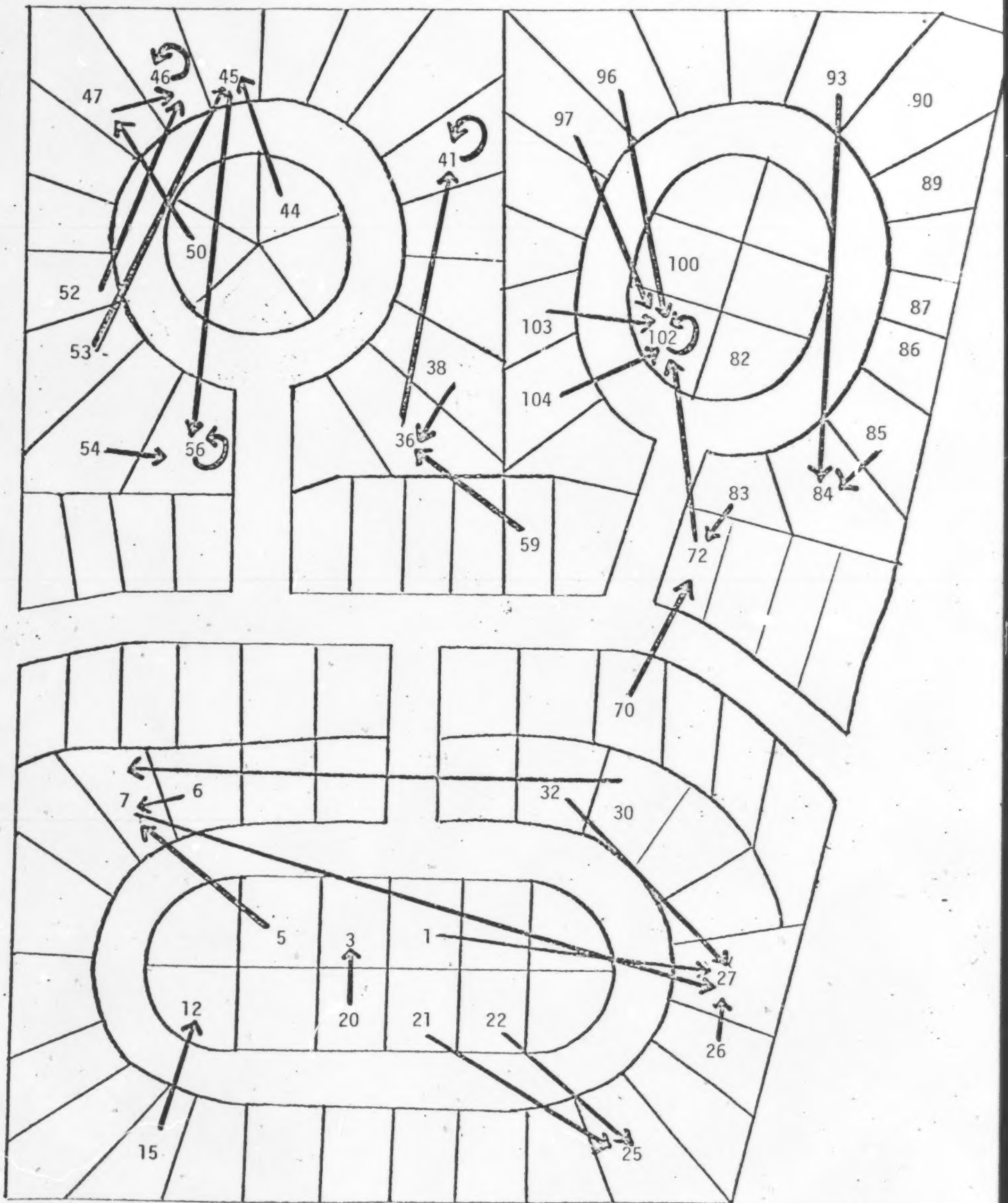

FIGURE 7: Homeowners nominated by their neighbors as the best sources of information about energy conservation.

Question: Please indicate on the map those houses you have been inside of at least once.

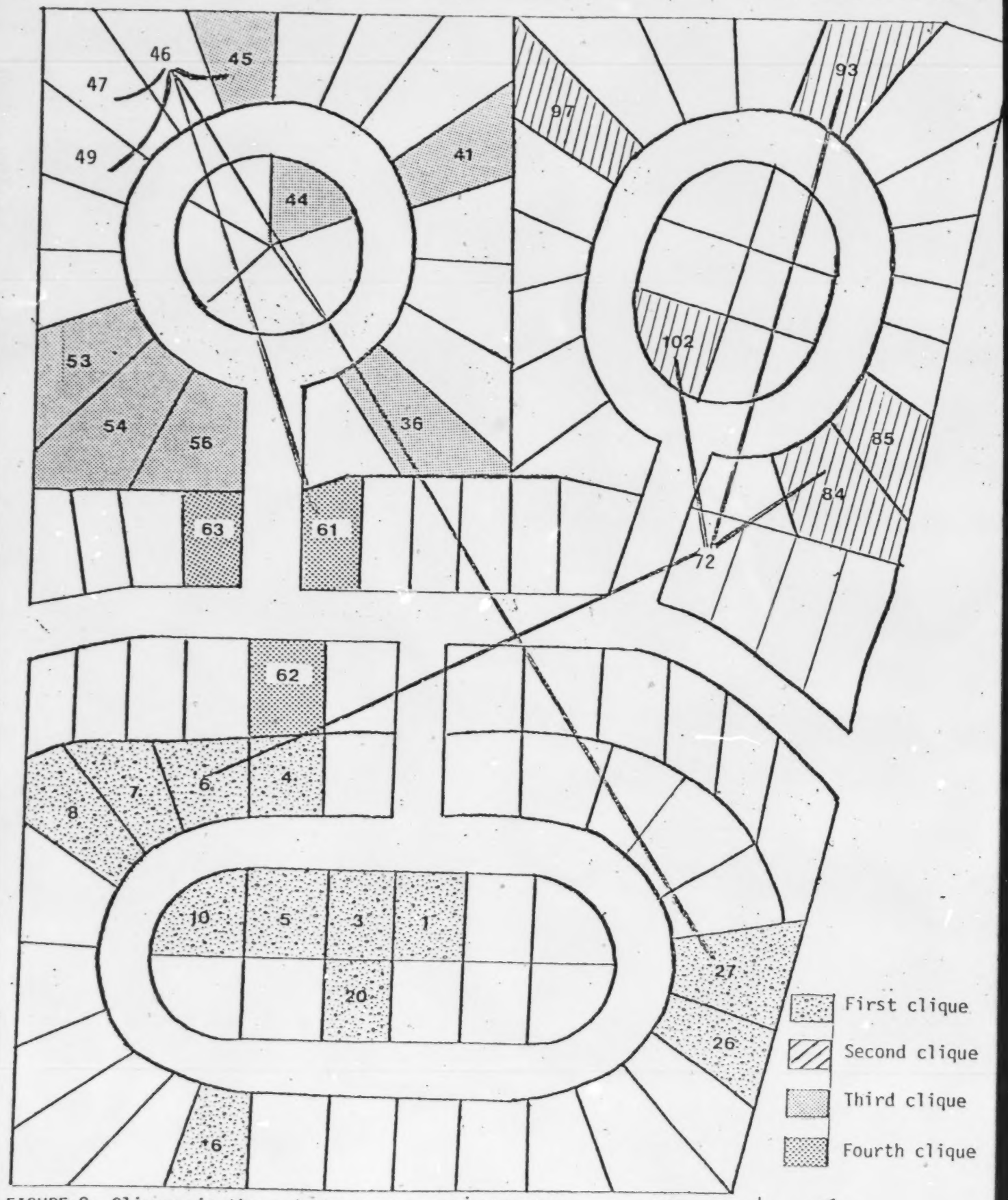

FIGURE 8: Cliques in the neighborhood as identified through sociometric groupings.

In this neighborhood #46 is a particularly useful individual because he has friends in three of the four cliques which were identified. If one wished to disseminate information about energy conservation in this neighborhood, #46 would be an excellent choice as an opinion leader and disseminator.

This network analysis is of interest primarily because this neighborhood might be regarded as a microcosm of society. We can see that these respondents are generally aware of who is actually using less gas in the neighborhood. Moreover, there is a high degree of consensus on sources of energy-related information in their neighborhood. This awareness of energy consciousness in the community is important for communication planners. A conservation ethic is much more likely to be observed when it is personified by a neighbor than when it is merely a disembodied principle stated repeatedly in mass media. As communication research has shown, interpersonal channels are extremely important in the diffusion of opinions and innovations. Opinion leaders serve as information brokers and information screeners. They sort out and evaluate information on a given topic, thereby saving their opinion-followers a lot of time and effort. Moreover, in the case of energy conserving practices, the homes of these opinion leaders sometimes serve as demonstration centers for conserving techniques. In one of the neighborhoods studied in the present research, the home of the key opinion leader on the subject of water and energy conservation was easy to identify because there were vegetables instead of flowers planted by the front door. Inside, a mass of improvised piping recycled water so that, for instance, sink water was used to irrigate the back lawn.

If, as our study suggests, mechanical know-how is an important determinant of adopting ECP, these neighborhood mini-demonstration centers may be of considerable utility in the diffusion of ECP. Neighbors can learn from each other techniques of conserving and how to construct equipment.

Discussion

The Importance of House Structure

As we can see from the fact that house type predicts 29 percent of the total 38 percent variance explained in gas consumption, homeowners are relatively constrained in the amount of energy they can save by the type of house they bought. Moreover, probably much more variance in gas usage could be explained if physical orientation of the house (north or south) were included in the regression. Although these structural considerations are not the intended primary focus of this study, the findings have several obvious implications for the planning of energy conservation campaigns.

First, people should be reached at the point of purchase, so that potential heat losses and the physical orientation of the house are entered in as factors to be considered in the home purchase decision.

Secondly, those individuals responsible for designing and building large tracts of houses should be a primary target for messages about energy conservation.

Thirdly, people considering renovation and remodeling should be targeted. Other studies conducted at the Institute for Communication Research suggest that major energy conservation investments, such as solar equipment, are most likely to be adopted at the same time other home renovations are being carried out, since home improvements loans can be readily expanded to cover costs, the house is already disrupted by construction, etc. Moreover, house renovations can be designed so as to take advantage of solar heat and with other energy conserving considerations in mind.

Behavior Clusters

One major conclusion of this study is that attitudes and beliefs, broadly defined, are not good predictors of energy conservation in the home. Our respondents appeared to approach energy conserving behaviors quite pragmatically,

evaluating these practices on the basis of their attributes, i.e., their immediate personal consequences for the adopter, and on the extent to which such acts fit in with other habitual behavior. That is, the homeowners in this study adopted ECP (and thereby lowered their gas usage) if they assessed the ECP positively, if the ECP fit in well with an already developed interest in home improvement, and if the homeowners felt their neighbors were adopting similar behaviors.

Communication Campaigns

The implication for communication campaigns is that general messages (e.g., FEA's "Don't be Fuelish") are probably of very little utility in promoting energy conservation. There is a definite role for information and persuasion, but the beliefs and attitudes which need to be addressed are very specific ones tied to particular ECP. Once people are aware of those ECP which have the greatest effect on their consumption levels and are convinced to adopt them, gas use drops.* Homeowners need to be reliably informed about how to adopt the ECP, and about the probable economic, technical and personal consequences of adoption.

Information can affect homeowners' perceptions of the effects of ECP, and therefore affect the likelihood of adoption. However, not all perceptions are equally susceptible to influence. For instance, for the ECP "turning down the furnace thermostat to 65° daytime and lower at night," comfort was the attribute which was most important in determining adoption levels for both high and low gas users. It may be possible to affect nomeowners' perceptions of how comfortable cool houses are;** however, it would probably be easier to influence perceptions of the attribute which high gas users deemed the next most important: convenience. Many homeowners do not know about automatic timers for the furnace.

*Pilati (1976) has estimated that about four percent of total U.S. energy use could be saved through just one ECP: the reduction of residential thermostats to 68° daytime and 55° during sleeping hours.

**If so many U.S. citizens discount the discomfort of running long distances daily because jogging is perceived as healthful, homeowners may well come to regard colder houses as health and energy-saving.

Such timers obviate the necessity for manual control of temperatures in the house, and are therefore quite convenient.

Likewise, homeowners can be made aware that turning off furnace pilot lights during summer months is safe, and saves a great deal of energy. Homeowners can be encouraged to perceive of insulation as an important consideration in home selection and therefore to value insulated houses more highly.

Practical how-to information can also affect the probability of adoption. Information about how to insulate or weatherstrip should be conveyed so as to provide even those individuals lacking mechanical ability, with the know-how to carry out the needed renovations to their homes; perhaps easily assembled energy-conserving kits should be promoted and installation service provided to the elderly. Those ECP which lack natural appeal will need the most active promotion. While there are solar training centers for the do-it-yourself solar installer springing up around the country, there does not appear to be any similar interest in training homeowners to do their own weatherstripping or insulation.

If homeowners can be encouraged to take some small steps towards making their homes energy-efficient (e.g., weather stripping) they may go on to larger ones (e.g., insulation). Social psychologists have found that once a person is committed to some small act, he/she can be more readily persuaded to a larger related action. This "foot-in-the-door" technique has been utilized to good effect in health and community action campaigns (Freedman and Fraser, 1966) and should be transferable to energy conservation programs. It may be that there are certain threshold activities which potential conservers engage in, which lead them to actions requiring progressively more commitment of time and resources. In Palo Alto, recycling is vastly more popular (85 percent of our respondents recycle newspaper) than swapping services in lieu of payment (27 percent do). Likewise, many more of our respondents reported turning down

the temperature of their hot water heaters than turned off their furnace pilot light during the summer (see Table 1). It would be interesting to find out if those who have learned to turn down their hot water heaters eventually begin to turn off the furnace pilot lights in summer.

The growth of a social norm to conserve may stimulate the adoption of those first threshold ECP. A decade ago, the ecology ethic which seems so strong in the U.S. today, was much less widespread. There is continual speculation as to whether there is an emerging conservation ethic -- a growing social pressure to conserve energy. Our findings suggest that, at least during the periods of community awareness such as that occasioned by the drought in California, the conservation ethic is alive and influential (whether the norm derives from behavior or vice versa). This finding, if confirmed by further research is important because it suggests:

1. The populace will accept belt-tightening measures if they perceive that others in their reference groups regard such conserving as necessary. A Presidential announcement of the "Moral Equivalent of War," or "MEOW" as an oil company exucutive dubbed it, will likely have little effect unless people believe that everyone will be equally affected.

2. Perceived social acceptance of conservation will aid in the maintenance of a new behavior (energy-conserving) until it becomes habitual and a part of daily routine. Social acceptance can also lend status to insulated houses and solar-heated hot water systems. Vocal support of a new idea tends to force the opposition into a "spiral of silence" and eventual acceptance (Noelle-Neumann, 1974).

3. People go to friends and acquaintances for know-how as well as for behavioral models of an innovation. The development of a community social norm favoring conservation will generate numerous opinion leaders on the subject who, as our sociometric data suggest, become known as infuential sources of

information on the topic.

In conclusion, we found that among our respondents, general attitudes towards and beliefs about energy were unimportant in predicting adoption of energy-conserving behavior and gas usage. The only direct behavioral predictor of gas usage is the adoption of energy conserving practices in the home. These practices, in turn, are predicted by a positive assessment of their attributes, experience with the necessity to conserve, conviction that reference group members share a belief in the value of energy conservation, and an ability to make minor renovations in the home. The impetus to conserve may be provided by neighborhood role-models -- homeowners who have adopted ECP and believe in the necessity of conservation.

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